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April – June 1994

Number 1009
Volume 119

The Naturalist

A QUARTERLY JOURNAL OF NATURAL HISTORY FOR THE NORTH OF ENGLAND

Published by the Yorkshire Naturalists' Union

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BAT PREDATION BY A TAWNY OWL

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INTRODUCTION

Bats are a major component of the diet of very few animals around the world, despite their tendency to form large and potentially vulnerable colonies. Several tropical and subtropical raptors specialise on bats (e.g. Eccles, Jensen and Jensen, 1969; Black, Howard and Stjernstedt, 1979; Fenton, Rautenbach, Smith, Swanepoel, Grossell and van Jaarsveld, 1994), but they are not a major food of any European birds of prey: the highest figure in the literature for a broad sample, rather than a single bird, is for the Tawny owl, *Stryx aluco*, in Germany, at 0.20% of all prey items (Uttendörfer, 1943). In a recent review of the literature, Speakman (1991) concluded that bats represented a very small component of the diets of birds of prey in the British Isles. Bats were only 0.0034% of the prey items taken by small hawks and falcons, and 0.047% of those taken by owls (not 0.035% as quoted), with three species of owl taking bats most frequently: tawny owl (*Strix aluco*, 0.05%), barn owl (*Tyto alba*, 0.051%) and long-eared owl (*Asio otus* 0.047%). There are occasional references to owls specialising in bat predation in eastern Europe. In this paper we present the pattern of bat predation by (probably) a single tawny owl over a six year period, determined from pellet analysis.

MATERIALS AND METHODS

Study site and pellet collection

The study site is a small wood adjacent to a sewage works on the outskirts of Leeds, West Yorkshire (Fig. 1). The wood is predominantly non-native pine species, with some oak (*Quercus robur*) and beech (*Fagus sylvatica*). The owl's territory included an area of semi-improved pasture. Pellets were found at the base of a number of pine trees within an area of approximately 50m x 50m. From September 1986 the site has been visited at the end of each calendar month and a thorough search carried out for pellets.

Analysis of pellets

All pellets were dried immediately after collection for 7-14 days in a bottom heating plant propagator. Their length and average diameter were measured, and each was allocated a reference number. Any fragments were put together to make average size pellets, but these made up <5% of the total material. Individual dry pellets were gently teased apart for analysis. Mammals were identified by the jaws or skulls, and the number of individuals estimated on the minimum jaw/skull count. Bird skulls were frequently missing (crushed during digestion or not swallowed by the owl) and the species were inferred from bones or an occasional feather, using a reference collection from known species. In some cases the species could not be determined with any degree of certainty, but a size could be assigned with some confidence. After removal of the vertebrate material, the matrix of the pellet was examined under a stereomicroscope. Earthworm chaetae indicated the presence or absence of earthworms. A large adult worm weighs 5g (Yalden, 1985). It has been assumed from the size of the chaetae that each pellet contained one large or several smaller worms of 5g total weight. Further details are given in Altringham, O'Brien and Julian (1994). Beetles, moths and caterpillars were identified from their heads.

Analysis of data

The numbers of each prey item found in the pellets were totalled over the study period. The monthly minimum number of bats (and other prey) was determined from the skeletal

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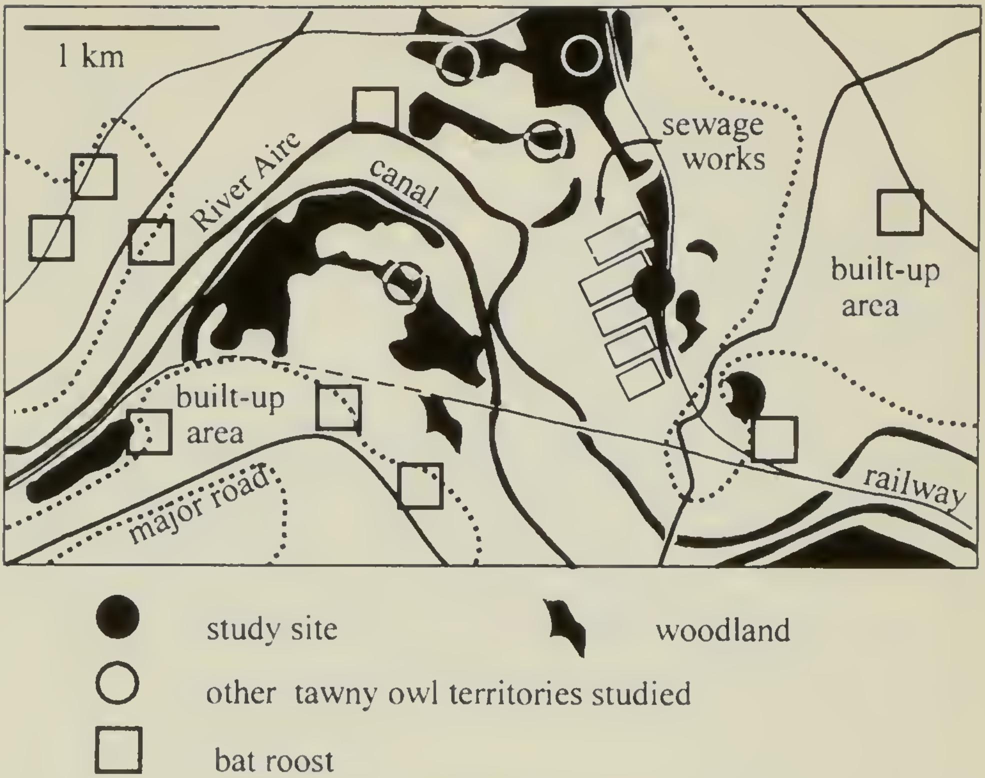

FIGURE 1
Map study site. Land not occupied by woodland or buildings is predominantly improved or semi-improved pasture or parkland.

remains, and divided by the number of pellets in that month, to compensate for variation in the number of pellets collected. Weights of live prey from the literature were used to calculate the total weight of each prey item. The prey weights used were taken from Yalden (1985) and Yalden and Morris (1990), and bird weights obtained from British Trust for Ornithology records and recorders (full details can be found in Altringham *et al.*, 1994). A study of captive long-eared, tawny, and barn owls showed that around 20%, 16% and 8% respectively of vertebrate prey were unaccounted for by subsequent pellet analysis (Raczyinski and Ruprecht, 1974). Lowe (1980) performed a similar study on tawny owls, and found that mean annual losses ranged from 14% of field voles to 22% of wood mice, with other mammals falling between these values. In contrast, Mikkola (1983, p. 35) carried out similar studies on four species of owl, including the tawny, and found that pellets reflected exactly the animals fed to them. Work on the short-eared owl, *Asio flammeus*, by Short and Drew (1962), and by Clark (1975) supports this view. Given this uncertainty, no corrections have been made for losses due to digestion.

Results

A total of 741 pellets were collected and analysed over the seven years from September 1986-November 1993. If tawny owls produce an average of two pellets/day (Wijnandts, 1984; Yalden & Morris, 1990), then we sampled an average of 13% of all pellets produced by a single owl each year, or 6.5% if the pellets were from two owls. These pellets contained the remains of a minimum of 72 pipistrelles (*Pipistrellus pipistrellus*) and eight noctules (*Nyctalus noctula*). Included in this are 98 pellets collected at the beginning of the study, which could not be assigned to a particular month. These were included in the above analysis, but not in the seasonal analysis which follows. In Fig. 2a, the mean number of pipistrelles/pellet is shown for each month, over the six years from October

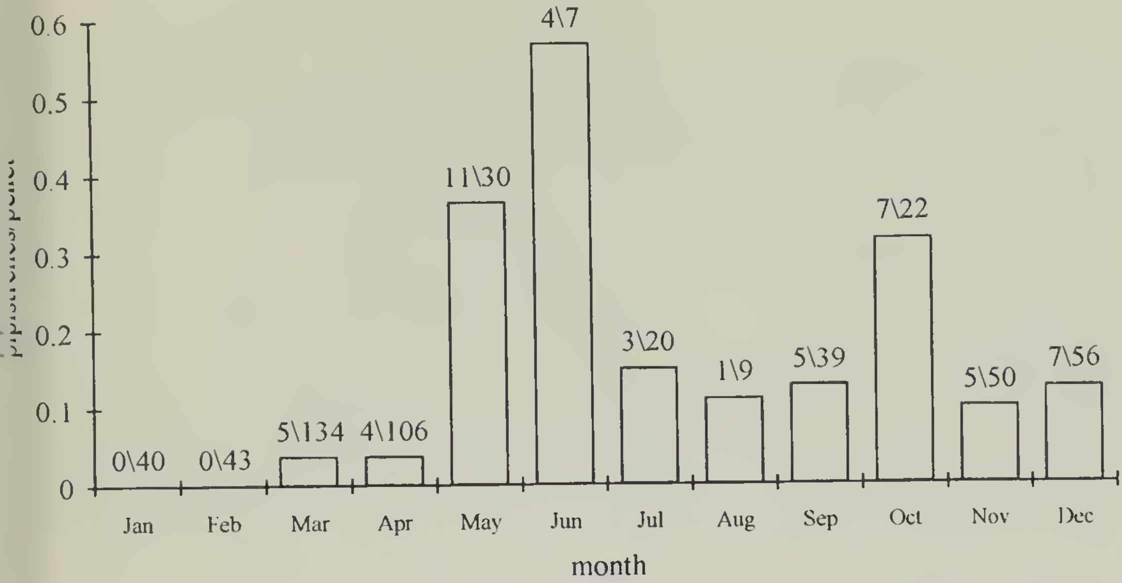

FIGURE 2a
Average number of pipistrelles/pellet for each month, over the period October 1986 to September 1992, determined by summing data for all years. Numbers above each column are total no. of bats/total no. of pellets.

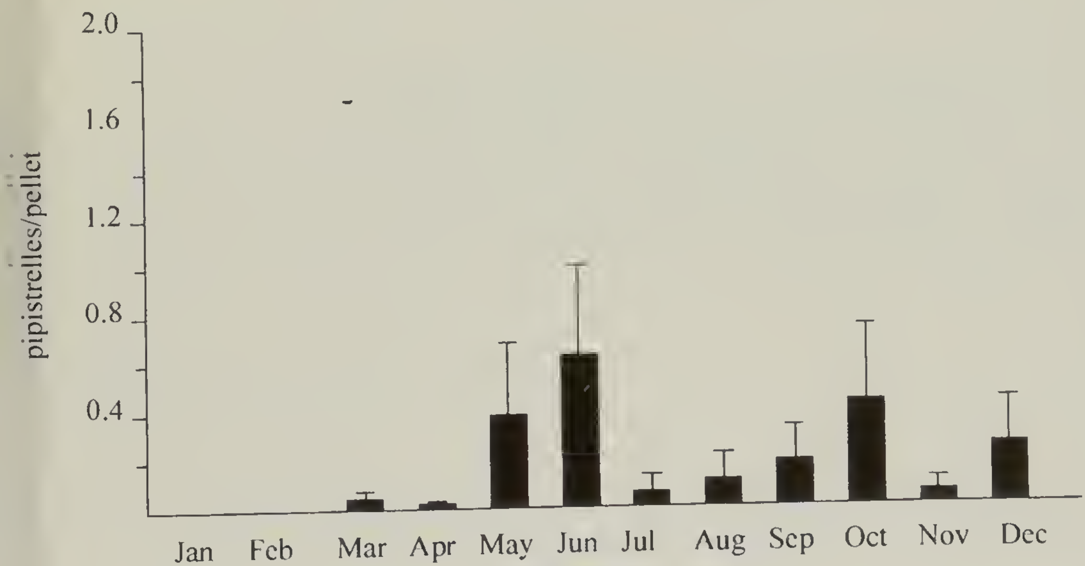

FIGURE 2b
Mean ± s.e. (n = 6) of the number of pipistrelles/pellet, worked out independently for each month over the six years. P>0.05, Kruskal-Wallis nonparametric ANOVA.

1986–September 1992, together with the total number of pipistrelles and pellets for each month. In Fig. 2b the value has been calculated separately for each month, rather than pooling over the six years for each month as in Fig. 2a. Fig. 2a hides the year to year variability, Fig. 2b is biased by the many months in which no bats were found. Only one bat was caught after 1992, and the remains of a tawny owl were found in the wood in the spring of 1993. We therefore suspect that this was the owl predating on bats: hence the removal of data from the seventh year from the analysis. The single pipistrelle caught after the study period was found in a pellet from January 1994. It seems most reasonable to

assume that this was caught by another owl, but we cannot confirm this. No significant seasonal variation was observed in the mean monthly bats/pellet over the six year period indicated (Kruskal-Wallis nonparametric ANOVA). However, several factors make it unlikely that any significant trends would be found. No pellets were found in 15 of the 72 months, with most missing data during the summer months. The low level of predation meant that no bats were found in many of the months in which pellets were collected, introducing many zeros into the data set. Finally, the number of pellets found in a given month was very variable, and showed a strong seasonal trend: fewer were found in the summer ($P<0.01$, Kruskal-Wallis nonparametic ANOVA). However, it is worth highlighting a number of points. Pipistrelles were caught in every month except January and February. The number of bats/pellet was high in May and June: in four of the six years, no pellets were found in June, but three pipistrelles were present in the three found in 1991, and one in the four pellets found in 1992. The mean number of bats/pellet between October 1986 and September 1992 was 0.12 (0.10 for pipistrelles only). If the owl produced two pellets/day (Wijnandts, 1984; Yalden & Morris, 1990), then this is equivalent to one bat every 4.2 days, or 88 bats/annum. The eight noctules were caught in April, September and December, between 1986 and 1991.

Full details of prey of this and other tawny owls in the study area will be given in a later publication. A summary of the diet of this owl is given in Table 1. Bats represent 7.51% of the number of vertebrate prey taken, and 3.96% of vertebrate prey by weight. These percentages fall to 4.58% of all prey, and 3.55% of all prey by weight. If some of the pellets are from another owl which is not catching bats, then these values underestimate the importance of bats in this owl's diet.

Discussion

Dietary trends in relation to bat activity – foraging strategy?

The pellets collected are most likely from two individuals. Male tawny owls set up territories which are vigorously defended (Mikkola, 1983), and the female is generally found in the territory throughout the year, sometimes roosting in the same tree as the male. A number of individual owls have been known to occupy the same territories for 10-13 years (references in Mikkola, 1983 p. 143). Since predation on bats by owls is rare in Britain (Speakman, 1991, and see below), it is probable that only one of the pair was catching bats: we know of no evidence to suggest that a pair of owls have similar hunting techniques. The number of pellets found fell during the breeding season, when the female was on the nest, and the male may also have changed his normal roosting patterns. Similar behaviour is seen in the long-eared owl, *Asio otus* (Wijnandts, 1984) and the little owl, *Athene noctua*, (Altringham, *et al.*, 1994). Bats were still a regular occurrence in pellets when the female was away at the nest, and in fact the proportion of bats in the diet increased late in the reproductive cycle (Fig. 2, May/June), although no statistically significant difference was observed, possibly due to the year to year variation. However, these results do suggest that the male was catching the bats. Our hypothesis that only one owl preyed on bats is based on circumstantial evidence, but it is probably the most reasonable, and is supported by the fact that only one bat has been found in pellets (13 months after the last bat) since the death of an owl on the territory.

Has the owl adopted a particular strategy which has enabled it to predate on bats so successfully? A look at the seasonal pattern of captures may give some clues. From May to August, both species of bat caught form large maternity colonies: those of the pipistrelle typically number 50-250 in this part of the country, those of the noctule rarely exceed 30 (unpublished results). Both species begin foraging before dark, the entire colony emerging within 20-40 min around sunset. Bats may return to the roost throughout the night, but most return at dawn, and swarm around the roost before entering. This very predictable evening emergence/dawn return is exploited by avian predators in other parts of the world, and bats are typically caught in flight at the roost entrance (Fenton *et al.*, 1994). The perch

hunting strategy typically adopted by many tawny owls would be ideal for preying on emerging or returning bats. The roosts themselves (of both pipistrelle and noctule) are unlikely to be accessible to the owls. The large number of bats taken in early summer could be explained by predation at a maternity roost. However, this would not account for the fall in July and August when the newly volant young increase the number of bats emerging, unless the maternity colony moves to a new roost at this time of year. In addition, all of the known roosts are outside the owls' likely territory (Fig. 1): tawny owls in England typically have territories of only 12-20ha (Southern, 1970). As stated in the previous paragraph, the increase in bats/pellet in May/June may be an artefact due to the absence of the female owl. Many bats are taken throughout the period from March to October, suggesting that predation at maternity roosts, if it is done, is not the only strategy. Many of the bats must therefore be taken either in flight when they are foraging or commuting, or at their night roosts: bats frequently roost in trees or buildings between foraging bouts, and have been taken by tawny owls from such sites (Mikkola, 1983 p. 145). In this context it is interesting to note the large number of small tree roosting birds, notably goldcrest, found in the pellets (Table 1). The territory lies in the bottom of the well-wooded Aire valley, and attracts large numbers of foraging bats, predominantly pipistrelles and noctules (unpublished observations). Owls generally cannot hear ultrasonic frequencies, and the echo-location pulses are unlikely to serve as a cue to the tawny owl. The bats are probably detected visually, or by their social calls, when in flight or roosting. Whatever the strategy, its success is apparent from the high ratio of bats/pellets found in some months e.g. 9:5 in May 1989; 5:3 in October 1986; 3:3 June 1991.

The absence of bats from the diet in January and February is expected, since these are the months of lowest bat activity (Racey, 1974). However, bats are also hibernating in November, and more particularly in December, and nocturnal activity is very low with only occasional flights to feed or drink (Avery, 1985; Avery, 1986; Speakman & Racey, 1989), yet bats were still caught in significant numbers. At this time of year the large maternity roosts have dispersed and pipistrelles typically roost singly or in small groups (Racey, 1974). Noctules almost invariably roost in trees throughout the year, usually in small groups (Howes, 1979). This again suggests a particularly effective hunting strategy. Did this owl learn how to exploit a particular aspect of bat behaviour? Pellets collected from four other tawny owl territories in the area (Fig. 1), over the same period, have yielded only one pipistrelle.

Effect of predation on local bat populations

Nine pipistrelle maternity roost sites have been identified in the vicinity (Fig. 1), but colony size is not known for several of them. Mean colony size in West Yorkshire is about 60 bats, so we can estimate the local pipistrelle population to be about 540 females, and the total population to be a little over 1,000, assuming a 1:1 sex ratio (the last assumption is supported by survey work on bat boxes in other parts of the county, paper in preparation). Most of the bats from these colonies forage in the valley bottom, and are potential owl prey. The annual recruitment into the local population from these colonies, assuming that the majority of females produce a single offspring each year, will be about 500 individuals, but mortality will be high in the first year. The population of noctules will be considerably lower. This owl, in taking over 80 bats/year, may have had a significant impact on local populations. As Speakman (1991) pointed out, even the very low level of predation typical of owls (0.05%) may be responsible for around 10% of annual bat mortality.

Despite numerous professional and amateur studies of owls in Britain, to the authors' knowledge no other case has been reported of an owl predating to such a marked extent on bats. In continental Europe, several studies report relatively high levels of predation. One of the most thorough studies was carried out by Ruprecht (1979) in which almost half a million vertebrate prey were identified from barn owl pellets from 428 sites in Poland. 20 of the 21 resident species of bat were taken, constituting 0.26% of total vertebrate prey by number, five times higher than Speakman's (1991) estimate for Britain. A sample of tawny

TABLE 1
Summary of diet September 1986 to September 1992.
Prey weight taken from the literature. See Methods for details.
Weights of pipistrelle and noctule from Racey, in Corbet and Harris (1993).

	total number of prey	mean weight of prey (g)	% total diet by weight	% total diet by weight
Mammals				
mole *Talpa europaea*	7	70	2.42	
shrew, common *Sorex araneus*	65	8	2.57	
Shrew, pygmy *Sorex minutus*	24	4	0.47	
shrew, water *Neomys fodiens*	12	12	0.71	
bat, noctule *Nyctalus noctula*	8	32	1.27	
bat, pipistrelle *Pipistrellus pipistrellus*	71	6.5	2.28	
mouse house *Mus domesticus*	1	12	0.06	
mouse, wood *Apodemus sylvaticus*	196	18	17.45	
rat *Rattus norvegicus*	2	100	0.99	
vole, bank *Clethrionomys glareolus*	111	16	8.78	
vole, field *Microtus agrestis*	128	21	13.30	
rabbit *Oryctolagus cuniculus*	7	200	6.93	**All mammals** 57.23
Birds				
blackcap *Sylvia atricapilla*	1	18.5	0.09	
goldcrest *Regulus regulus*	118	5.7	3.33	
robin *Erithacus rubecula*	5	19.3	0.48	
blackbird *Turdus merula*	7	95	3.29	
songthrush *Turdus philomelos*	6	76	2.26	
tit, blue *Parus caeruleus*	23	13.3	1.51	
tit, coal *Parus ater*	9	9.1	0.41	
tit, great *Parus major*	10	19	0.94	
chaffinch *Fringilla coelebs*	20	20	1.98	
goldfinch *Carduelis carduelis*	2	15.6	0.15	
greenfinch *Carduelis chloris*	3	27.8	0.41	
starling *Sturnus vulgaris*	13	82	5.27	
magpie *Pica pica*	4	237	4.69	**All birds** 24.81
Amphibians				
frog, common *Rana temporaria* (13 of these may have been toad)	76	20	7.52	**All amphibians** 7.52
Invertebrates				
earthworms *Lumbricus* species	395	5	9.77	
caterpillars	78	1	0.39	
moths	9	1	0.04	
beetles	192	0.25	0.24	**All invertebrates** 10.44
TOTAL	**1,726**		**100**	**100**

owl pellets contained only 11 species, and the analysis was not completed due to its small size. Ruprecht (1979) cites a number of reports of bats constituting 3.3-4.2% of all vertebrate prey of tawny owls in eastern Europe, with an exceptional 12.5% (all daubenton's bat, *Myotis daubentoni*) from one site. Uttendörfer (1943) gives values of 0.15 and 0.20% for barn and tawny owl respectively in Germany. Mikkola (1983) summarizes results from studies of five species of owl throughout northern and western Europe, including Britain: bats constituted only 0-0.95% of prey items taken. Ruprecht (1979) concludes that the tawny owl is the most important bat predator. The lower predation rate generally observed in Britain may be due to the scarcity of large bat species, which the owls appear to prefer. 32% of the bats in barn owl pellets studied by Ruprecht were serotines, *Eptesicus serotinus*, and 18% greater mouse-eared bat, *Myotis myotis*. The tawny owl pellets contained 34% noctules and 26% greater mouse-eared bat. All three species are large, typically 20-40g. The noctule is the only relatively common large bat in Britain: smaller bats may be more difficult to catch, and therefore less profitable prey. This particular tawny owl presumably learnt how to make bat predation pay, allowing it to exploit this resource far more heavily than is usual.

ACKNOWLEDGEMENTS

Thanks to Margaret Hartley for her invaluable assistance in prey identification, Tiawanna Taylor for her efforts with the spreadsheet, and Paul McErlain-Ward for useful discussions.

REFERENCES

Avery, M. I. (1985) Winter activity of pipistrelle bats. *J. Anim. Ecol.* **54**: 721-738.

Avery, M. I. (1986) The winter activity of noctule bats (*Nyctalus noctula*). *J. Zool. Lond.* **209**: 296-299.

Altringham, J. D., O'Brien, S. and Julian, S. (1994) The feeding ecology of little owls (*Athene noctua*) at an upland site in northern England. *J. Zool. Lond.* (submitted).

Black, H. L., Howard, G. and Stjernstedt, R. (1979) Observations on the feeding behaviour of the bat hawk (*Machaerhamphus alcinus*) *Biotropica* **11**: 18-21.

Clarke, R. (1975) A field study of the short-eared owl, *Asio flammeus* in North America. *Wildl. Monog.* **47**: 1-67.

Corbet, G. B. and Harris, S. (1993) *Handbook of British Mammals*. 3rd edition. Blackwell, Oxford.

Eccles, D. H., Jenson, R. A. C. and Jensen M. K. (1969) Feeding behaviour of the bat hawk. *Ostrich* **40**: 26-27.

Fenton, M. B., Rautenbach, I. L., Smith, S. M., Swanepoel, Grossell, J. and van Jaarsveld, J. (1994) Bats and raptors: threats and opportunities. *Anim. Behav.* (in press).

Howes, C. A. (1979) The noctule bat, *Nyctalus noctula*, in Yorkshire. *Naturalist* **104**: 31-38.

Lowe, V. P. W. (1980) Variation in digestion of prey by the Tawny Owl. *J. Zool. Lond.* **192**: 283-293.

Mikkola, H. (1983) *Owls of Europe*. Poyser, Calton.

Racey, P. A. (1974) The temperature of a pipistrelle hibernaculum. *J. Zool. Lond.* **173**: 260-262.

Raczyinski, J. & Ruprecht, A. L. (1974) The effect of digestion on osteological composition of owl pellets. *Acta Ornithol.* **14**: 25-38.

Ruprecht, R. L. (1979) Bats (Chiroptera) as constituents of the food of barn owls *Tyto alba* in Poland. *Ibis* **121**: 489-494.

Short, H. L. and Drew, L. C. (1962) Observations concerning behaviour, feeding and pellets of short-eared owls. *Amer. Midl. Nat.* **67**: 423-433.

Southern, H. N. (1970) The natural control of a population of tawny owls, *Strix aluco*. *J. Zool. Lond.* **162**: 197-285.

Speakman, J. R. and Racey, P. A. (1989) Hibernal ecology of the pipistrelle bat: energy expenditure, water requirements and mass loss, implications for survival and the function

of winter emergence flights. *J. Anim. Ecol.* **58**; 797-813.
Speakman, J. R. (1991) The impact of predation by birds on bat populations in the British Isles. *Mammal Rev.* **21**: 123-142.
Uttendörfer, O. (1943) Fledermäuse als Raubvögel und Eulenbeute. Z. Säugetierk. **15**: 317-319.
Wijnandts, H. (1984) Ecological, energetics of the long-eared owl (*Asio otus*). *Ardea* **72**: 1-92.
Yalden, D. W. (1985) Dietary separation of owls in the Peak District. *Bird Study* **32**: 122-131.
Yalden, D. W. & Morris, P. A. (1990) *The Analysis of Owl Pellets. Occ. Pubs Mammal Soc.* No. 13. London.

BOOK REVIEW

Roses of Great Britain and Ireland by **G. G. Graham** and **A. L. Primavesi**. Pp. 208 including numerous illustrations and 32 distribution maps. Paperback, B.S.B.I. Publications, 1993, £11.50 including postage and packing.

The 7th Handbook of the Botanical Society of the British Isles is the first complete revision of the British roses for over 60 years. The opening chapters deal with the historical background, and problems of identification due to hybridisation and the peculiar method of reproduction of the Dog Roses. Then follow chapters on morphology, with helpful diagrams, ecology and distribution of species, and the collecting of specimens.

The main part of the book consists of descriptions, with excellent illustrations by Margaret Gold of 12 native and 8 introduced species. Descriptions are also given of 83 hybrids. Then follow the distribution maps and a bibliography. From 1930-31, British specimens were invariably determined according to A. H. Wolley-Dod's *Revision of British Roses* which gives over 200 named species, varieties and forms. The present authors have successfully reduced this total to a manageable number of species and hybrids, though allowing for a degree of introgression. It may come as a shock to those of us who have collections of roses named by the late R. Melville to find that the number of taxa are greatly reduced, this especially so if collected in a V-c. where *Rosa canina* is predominant and over 40 names are reduced to four groups. It would have been helpful if a limited synonymy had been given. For instance, *Rosa glauca* Villers ex Lois, *R. vosagiaca* Desportes, *R. afzeliana* Fries and now *R. caesia* ssp. *glauca* (Nyman) G. G. Graham & Primavesi have all been used for the same taxon since 1958.

The distribution maps are slightly disappointing despite being the first available in most cases. Many of the maps for hybrids have too few records to give a meaningful distribution, and those for commoner species and groups, e.g. *R. obtusifolia* and *R. canina* group Lutetianae, tend to show the working area of the authors. It is admitted that the maps are a starting point and it is to be hoped that those who hold collections of roses and records will now be able to re-assess and submit them for mapping. To this end and for future work, two keys are provided.

This Handbook will be the standard work on British roses for some time to come and is essential for anyone interested in the genus, and indeed for mapping in general if any progress beyond *R. canina* agg. is required.

EC

LICHEN FLORA OF THE WEST YORKSHIRE CONURBATION – SUPPLEMENT V (1991-93)

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The improved status of lichens throughout the conurbation over the past 21 years is clearly demonstrated in Figure 1, which has been constructed from multidirectional transect work to distances of 18 km from the centre of the conurbation (grid ref. 44/200.300). All zones show species gains, but those in central urban areas are less impressive. Clearly, the increase in species diversity reflects falling air pollution levels, particularly sulphur dioxide, but other factors should also be considered.

Firstly, nutrient enrichment continues to influence saxicolous, corticolous and lignicolous floras (see Seaward & Henderson 1991), mainly in suburban areas. Secondly, urban wastelands have been found to be highly productive in terms of lichen species diversity counts (Gilbert 1990), and, as can be seen below, those contaminated with metalliferous waste can support unusually rich lichen floras locally. Such sites, despite their history of air pollution, offer a wide range of habitats suited to diverse lichen species. This diversity is mainly due to the considerable variety of substrata and edaphic conditions present; for example, the industrial waste area of Kirkstall Forge engineering works (where iron ceased to be worked in 1920) includes stone, pebbles, gravel, brick, asbestos-cement, mortar and concrete, worked metal and iron slag, clinker and cinders, slate, potsherds, cloth and leather, bone, bark and lignum and rabbit droppings which support or influence particular lichens. The occurrence at this particular site of locally strong colonies of terricolous *Cladonia ramulosa, Peltigera rufescens, Sarcosagium campestre* and *Vezdaea leprosa*, and the presence of *Lecidea polycarpella* (only the second British record), *Micarea excipulata, Porpidia platycarpoides* and *Verrucaria dolosa*, for example, are a clear indication of the significance of such diverse habitat availability.

As well as assembling new evidence on the changing lichen flora of the conurbation, research continues on earlier observations of the region's lichen flora and those who studied it. Such work involves examination of herbarium collections, and of published and unpublished material. For example, in Seaward (1975, p. 145 & p. 194), reference is made to an undated record of *Lobaria scrobiculata* collected by John Lightfoot (1735-1788) from near Halifax. Although this record is substantiated by herbarium material at The Natural History Museum, London, details of any other lichen collections Lightfoot made in Yorkshire are lacking, and the whereabouts of his main lichen herbarium is unknown. His flowering plant and, to a lesser extent, pteridophyte, bryophyte and algal material is housed as a separate collection at the Herbarium of the Royal Botanic Gardens, Kew (Bowden 1989). Lightfoot remains a shadowy figure, but Bowden (1989) has succeeded in assembling such scanty biographical information as is available, mainly from correspondence, in detailing his travels and in cataloguing his collections. As a result, it is now possible to date the *L.scrobiculata* record above as 9-10 October 1772, which was made on his return from a tour of Scotland and the Hebrides with Thomas Pennant (1726-1798); Lightfoot used this occasion to 'call here upon his old correspondent' Thomas Bolton, brother of James (*fl.c.*1758 – *d.*1799), the famous Halifax painter and naturalist (see Watling & Seaward 1981).

The following list of lichens includes additions to the flora together with changes in

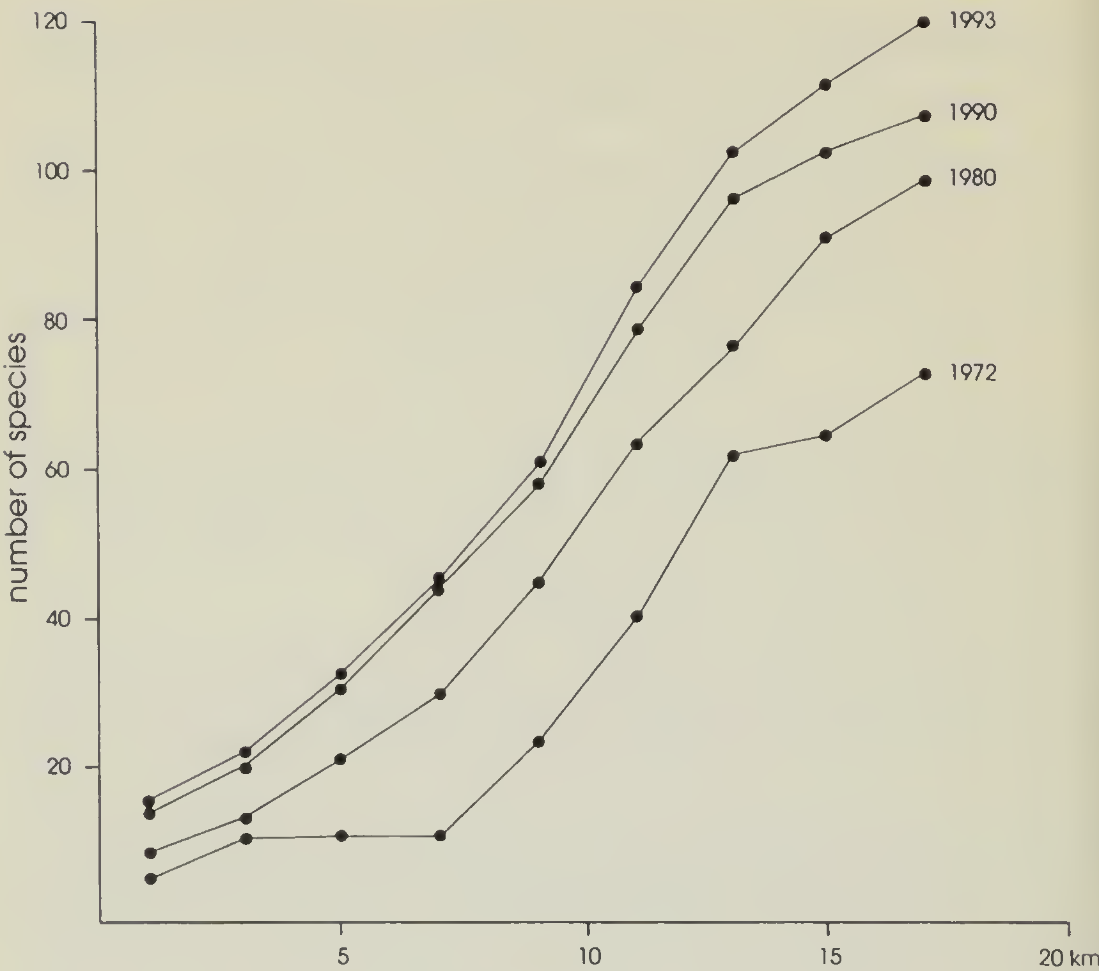

FIGURE 1
Relationship between lichen diversity and distance from the centre of the West Yorkshire conurbation in 1972, 1980, 1990 and 1993.

status and distribution of other taxa over the past three years based on recording units given in Seaward (1978, Figure 1 & Table 1); recording units A–S are within urbanized areas of the conurbation and T–W are non-urbanized but within 20 km of the centre of the conurbation. Collectors are abbreviated as follows: AH = A. Henderson, CJBH *et al.* = C. J. B. Hitch, P. N. Cayton and P. M. Earland Bennett, MRDS = M. R. D. Seaward, OLG = O. L. Gilbert, and PME-B = P. M. Earland-Bennett.

Acarospora heppii (Naeg. ex Hepp) Naeg. ex Körber Add M, U.
A.smaragdula (Wahlenb.) Massal. Add U.
Aspicilia calcarea (L.) Mudd Add U.
Baeomyces rufus (Huds.) Rebent. Add M.
Caloplaca saxicola (Hoffm.) Nordin Add E.
Catillaria chalybeia (Borrer) Massal. Add E.
C.lenticularis (Ach.) Th.Fr. Add E. First record within urbanized area of conurbation.
Cladonia pocillum (Ach.) O. J. Rich. Add M. First record within urbanized area of conurbation.
C.ramulosa (With.) Laundon Add M. First record within urbanized area of conurbation.

Coelocaulon muricatum (Ach.) Laundon Add U.

Collema limosum (Ach.) Ach. Add (M). On soil of derelict site, PME-B 1992; first modern record and first ever record within urbanized area of conurbation; now presumed extinct due to recent housing development.

C.tenax (Swartz) Ach. Add M.

C.tenax var. *ceranoides* (Borrer) Degel. Add M.

Evernia prunastri (L.) Ach. Add C, M. Further recolonizations into the urbanized area, but with only limited success in establishing itself.

Fuscidea cyathoides (Ach.) V. Wirth & Vezda Add U.

F.praeruptorum (Du Rietz & Magnusson) V. Wirth & Vezda Add U.

Hypogymnia physodes (L.) Nyl. Add E.

H.tubulosa (Schaerer) Havaas Add E .

Lecania cyrtella (Ach.) Th. Fr. Add E. On *Fraxinus*, CJBH *et al.* 1991; new to WYC.

L.hutchinsiae (Nyl.) A. L. Sm. Add M. On sandstone and mortar (base of N wall of church) PME-B 1993; new to WYC.

Lecanora aitema (Ach.) Hepp Add U. On wooden seat, PME-B 1991; new to WYC.

L.albescens (Hoffm.) Branth & Rostrup Add U.

L.chlarotera Nyl. Add D. On *Acer*, PME-B 1992; first modern record for the conurbation.

L.crenulata Hook. Add M. On calcareous tombstone, CJBH *et al.* 1991; first modern record for conurbation.

L.expallens Ach. Add C. On *Acer*, MRDS & OLG 1992 .

L.saligna (Schrader) Zahlbr. Add D.

Lecidea fuscoatra (L.) Ach. Add M. On siliceous tombstone, CJBH *et al.* 1991.

L.polycarpella Erichsen Add M. On brick on metalliferous industrial waste, PME-B 1988; new to WYC; second British record.

Leptogium gelatinosum (With.) Laundon Add M. On urban wasteland, AH 1993; new to WYC.

Micarea excipulata Coppins Add M. On brick, slate and wood on metalliferous urban waste, PME-B 1993; new to WYC.

Parmelia subaurifera Nyl. Add C, U.

P.sulcata Taylor Add C.

Peltigera rufescens (Weis) Humb. Add M. On urban wasteland, AH 1993; first modern record and first record within urbanized area of conurbation.

Physcia adscendens (Fr.) H. Olivier Add C.

P.caesia (Hoffm.) Fürnrohr Add E. Normally saxicolous, but spreading onto *Acer* and *Fraxinus*.

P.tenella (Scop.) DC. Add C.

Placynthiella dasaea (Stirton) Tonsb. Add M. On wood (urban wasteland) , PME-B 1993; new to WYC.

P.icmalea (Ach.) Coppins & P. James Add C.

Porpidia macrocarpa (DC.) Hertel & Schwab Add M.

P.platycarpoides (Bagl.) Hertel (cf. earlier *Lecidea* ? *percontigua* records) Add M. On sandstone pebble on industrial waste, PME-B 1993; new to WYC.

P.soredizodes (Lamy ex Nyl.) Laundon Add M (on siliceous tombstone, CJBH *et al.* 1991), add U; new to WYC.

Ramalina farinacea (L.) Ach. Add (C) (on *Acer*; now extinct), U (on *Fraxinus*); further recolonizations within the urbanized area, but failing to establish itself successfully.

Rhizocarpon concentricum (Davies) Beltr. (cf. *R.petraeum* in Seaward 1975, p. 199) Add U.

Rinodina exigua Gray Add M. First record within urbanized area of conurbation.

Sarcosagium campestre (Fr.) Poetsch & Schied. Add M. On metalliferous industrial waste, AH 1993; new to WYC.

Stereocaulon vesuvianum Pers. Add U.

Strangospora pinicola (Massal.) Körber Add E. On bole of *Fraxinus*, MRDS 1991.

Thelidium zwackhii (Hepp) Massal. Add (M). On bare soil of derelict site, PME-B 1992; new to WYC; now extinct.

Trapelia obtegens (Th. Fr.) Hertel Add E, U.

T.placodioides Coppins & P. James Add W.

Trapeliopsis flexuosa (Fr.) Coppins & P. James Add U.

Usnea subfloridana Stirton Add E. Further recolonizations of the urbanized area, but with limited success in establishing itself.

Verrucaria dolosa Hepp (cf. V.? *mutabilis* record in Seaward 1975, p.201) Add M. On iron slag on industrial waste, PME-B 1993; new to WYC.

Vezdaea leprosa (P. James) Vezda Add M. On metalliferous spoil of urban wasteland, AH 1993; new to WYC.

V.retigera Poelt & Dobbeler Add M. On cloth (urban wasteland), PME-B, 1993; new to WYC.

Xanthoria calcicola Oxner Add M.

X.candelaria (L.) Th. Fr. Add C, U. Spreading into conurbation, particularly on *Acer* and *Fraxinus*.

As a consequence of the above work, the lichen flora of the West Yorkshire conurbation can be summarized as follows: 350 lichen taxa have been reported from the area within 20 km of the centre of the conurbation, of which 5 are doubtful in the absence of supporting herbarium material and at least 32 are extinct in the area; 217 taxa have been recorded during the present survey (October 1967–December 1993), two of which have recently become extinct.

ACKNOWLEDGEMENTS

We are grateful to Mrs P. N. Cayton, Dr C. J. B. Hitch and Dr O. L. Gilbert for their field records, and to Dr B. J. Coppins for his identification of the more critical material.

REFERENCES

Bowden, J. K. (1989) *John Lightfoot: his work and travels.* Royal Botanic Gardens, Kew/Hunt Institute for Botanical Documentation, Carnegie Mellon University, Pittsburg.

Gilbert, O. L. (1990) The lichen flora of urban wasteland. *Lichenologist* **22**: 87-101.

Seaward, M. R. D. (1975) Lichen flora of the West Yorkshire conurbation. *Proc. Leeds Phil. Lit. Soc.* (sci.sect.) **10**: 141-208.

Seaward, M. R. D. (1978) Lichen flora of the West Yorkshire conurbation – supplement I (1975-1977). *Naturalist* **103**: 69-76.

Seaward, M. R. D. and Henderson, A. (1991) Lichen flora of the West Yorkshire conurbation – supplement IV (1984-90). *Naturalist* **116**: 17-20.

Watling, R. and Seaward, M. R. D. (1981) James Bolton: mycological pioneer. *Arch. Nat. Hist.* **10**: 89-110.

THE CHANGING STATUS OF RED GROUSE *LAGOPUS LAGOPUS* ON PERIPHERAL MOORLANDS IN THE PEAK DISTRICT

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INTRODUCTION

In 1969-1971, the moorlands of the Peak District were surveyed to establish the presence or absence of Red Grouse in the one kilometre squares of the national grid (Yalden, 1972) and these results were later interpreted to estimate the size of the breeding population at that time (Yalden, 1979). In 1990, the moors of the Peak District and further north up the Southern Pennines were re-surveyed by the Nature Conservancy Council (Brown & Shepherd, 1991) for all moorland bird species, including Red Grouse. They reported a distribution of Red Grouse which seemed essentially the same as that found 20 years previously, but noted two statistically significant changes. One of these was an increase in the population on the south eastern moors of the Peak District, which is probably genuine, the result of improved moorland management there in the interim, and does not concern us further. The other concerns an apparent decrease in the south west of the Peak District, but they noted that the 1990 resurvey concentrated on main blocks of moorland, and omitted many of the smaller peripheral patches, which are particularly a feature of the south west. Thus comparisons there between the 1990 and 1970 surveys are especially uncertain, prompting this resurvey of such peripheral areas. Moreover, it would be expected that any changes in distribution or status of Red Grouse would be most obvious in such areas.

METHODS

The basic unit of survey, in all cases, has been the one-kilometre square of the national grid. Squares where grouse, or signs (feathers, droppings), were recorded in 1969-1971 but which were either not surveyed in 1990, or were surveyed without success, were targeted for re-examination. Surveying was conducted in October-March of 1993 and 1994. Grouse are essentially sedentary, and, having taken their territories in the autumn, stay in them throughout the winter unless displaced by severe snow-cover. Neither winter was severe in the Peak District, and survey work was not conducted in bad weather or snowy conditions. This survey period has the further advantage that shooting mortality and disturbance had finished (counts in July-September are often inflated by family parties or larger coveys) but the breeding season, when both sexes but hens in particular become secretive and harder to survey (without dogs), had not begun.

Grouse seen were counted, with every effort being made to avoid duplication of counts; signs of grouse were noted where grouse themselves were not seen. Survey visits were also timed, but some patches of peripheral moorland were so small that this was not worth while. Where counts lasted more than 30 minutes, the results were expressed as grouse seen per hour, and compared with some similar counts made on the main moorlands during the same winter periods. A subjective note was made of the condition of the moorland, its area in hectares, and obvious significant changes in its management since the areas were first visited over 20 years ago.

RESULTS

1993-1994 Survey. In 112 one-kilometre squares covered by the survey, 238 grouse were counted in 64 squares (57%); 41 squares (37%) had no grouse, and only traces were seen in another 7 squares. The mean count for 106 squares which were resurveyed from 1969-1971 was 2.13 Red Grouse seen per km^2, with 95% confidence limits of 1.55-2.71 grouse/km^2 (Table 1).

For 29 timed counts on these peripheral moors which lasted more than 30 minutes, the mean count was 3.98 grouse per hour, and the median 3.2 grouse/hr (range 0-10.8). A

sample of 15 similar timed counts on main moorland areas in the same winter survey periods averaged 15.42 grouse/hr (median 13.3 grouse/hr, range 7.7-30.2); there were about 4 times as many grouse on the main moors, and the difference is highly significant (Meddis non specific test, $H = 6.13$, $p = 0.013$).

1969-1971 Survey revisited. In 106 of these one-kilometre squares surveyed in 1969-1971, 752 grouse were counted in 90 squares (85%); only 10 (9%) had no grouse though a further 6 had only traces. The mean count was 7.09 grouse/km^2, with 95% confidence limits of 5.00-9.18 grouse/km^2 (Table 1).

TABLE 1
Numbers of Red Grouse seen on peripheral moors (1km square) in the Peak District.
(Total, mean and S.D. for Grouse in 1993-94 refer to the 106 resurveyed squares).

Number of Grouse seen	1969-71	1993-94
0	10	41
traces	6	7
1-4	44	51
5-9	20	9
10-19	19	4
20+	7	0
Total Squares	106	112
Total Grouse	752	226
Mean Grouse/km^2	7.09	2.13
S.D.	10.99	3.03
95% CL	5.00-9.18	1.55-2.71

Comparisons between surveys. All the available indices indicate that grouse have declined sharply in these peripheral moorlands in the 20 years between these surveys. The densities of grouse for the 106 resurveyed squares are significantly different ($t=4.48$, $p <0.001$), with the 1990s population only 30% that of the 1970s. Far more of the survey squares had no grouse in the 1990s (aggregating "zero" and "traces only" squares, $\chi^2 = 20.2$, $p = 0.00006$). Comparing the actual counts for each square on the two dates, 17 squares showed an increase and 81 showed a decrease. Only 8 squares produced no change, but 5 of these were zero counts both times. If the grouse population was essentially stable one would expect, by chance, equal numbers of increases and decreases; these results differ significantly (omitting the "no change" category, $\chi^2 = 41.8$, $p<0.00001$).

In general, these changes were explicable by the evident changes in management. The map (Fig 1) identifies some of the more interesting cases. There has been some deliberate conversion of heather moorland to pasture, by ploughing and reseeding, by manuring, and by enforced overgrazing, using cattle, horses and sheep. This is particularly evident on the Bradfield Moors and around Gibraltar rocks, where 12 decrease squares were recorded, but is also true for 2 squares on Bradwell Moor, 1 square on Gun Hill and 1 square on Goldsitch Moss. Similar deliberate conversion, involving both tree planting and conversion to pasture, affected Matlock Moor (2 squares) and White Lee Moor (1 square). A second, less acute, cause of losses occurred on moors which are overgrazed by sheep. Often this accompanied continued management of the heather by burning; it is uncertain whether the intention is to retain a grouse moor or improve the sheep grazing. Light sheep grazing can be beneficial, but moors scored as overgrazed are those where heather is clearly damaged, flowering badly, and where recent burns are regrowing as grass or sheep's sorrel rather

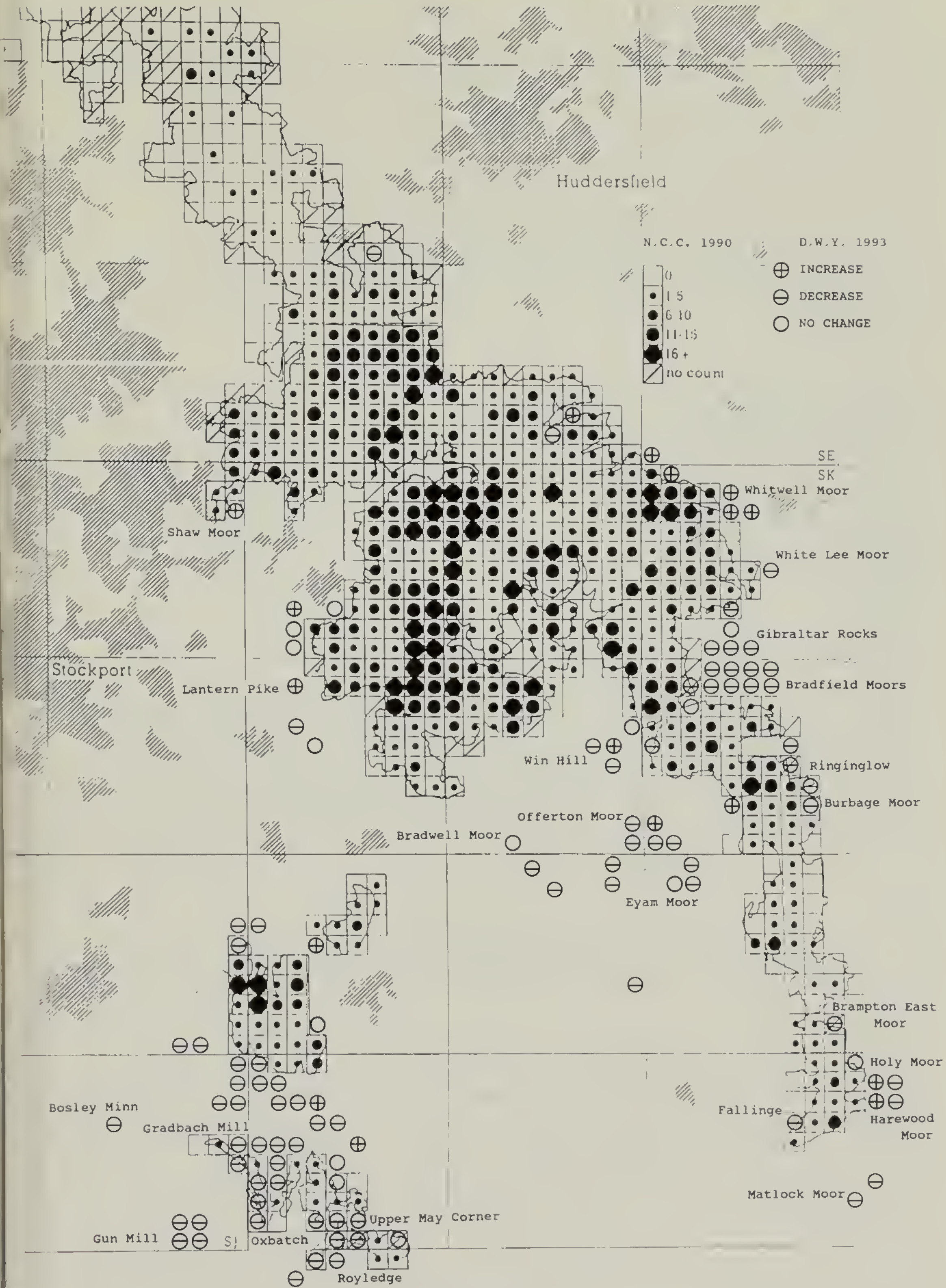

FIGURE 1

Distribution of Red Grouse in the Peak District by one-kilometre squares, based on Brown & Shepherd (1991), Figure 9. The solid dots record their survey results, open circles indicate peripheral squares surveyed for this study. (Base map reproduced by kind permission of Dr A. F. Brown and J.N.C.C.).

than heather. This cause of decrease is very evident in the Offerton Moor-Eyam Moor area (8 squares) and on Win Hill (2 squares). In a less acute form, some of the south western moors (Bosley Minn, Gun Hill, Royledge, Oxbatch, Upper Hay Corner) are affected, and there is a notoriously bad case on Gradbach Hill. Some of the south eastern moors (Fallinge, Harewood Moor, Holy Moor) and the edges of the eastern moors (Brampton East, Burbage, Ringinglow) similarly show decreases attributed to this cause. A third cause of decrease concerns moors which have gone out of active management as grouse moors since the 1970s; several sites in the south west Peak District, on the Warslow Moors of the former Harpur-Crewe Estate and the nearby Roaches area of the former Swythamley Estate, perhaps 17 squares in all, fall into this category. In many cases, work to reverse this decline has already been initiated, and both the extent of the moorland and the size of the Red Grouse population seems to be stable, though not yet obviously recovering to its former level.

This argument, that evident management changes explain many of the declines, is validated by the contrary cases. Though there were few increases, and some of them were statistically trivial, three were noteworthy. Lantern Pike, a National Trust hilltop, had no grouse, and virtually no heather, when surveyed in 1969 and 1971, but had 12 Red Grouse on about 17 ha of heather moor in 1993; deliberate fencing and exclusion of sheep for some years had produced this change. The Hollingworth Hall-Shaw Moor area had been abandoned as a grouse moor in 1969, but had 17 Red Grouse in two squares; it is now, in part, restored as a grouse moor and had 22 Red Grouse in three squares. Whitwell Moor had only 2 grouse in one square in 1971, when it was 35 ha of grassy heather moor and unmanaged; it is now lightly grazed by cattle, has 115 ha of heather, and had 11 grouse in 1992-1993.

Discussion

The 1969-1971 survey was intended to record distribution, rather than abundance of Red Grouse, and squares were surveyed throughout the year. Thus numerical comparisons with the 1993-1994 visits might be suspect, but against this, 72 out of the 106 squares in the comparison were in fact visited in the same winter period during both surveys.

The NCC's survey in 1990 was undertaken wholly during the breeding season for moorland birds, when Red Grouse are at their least conspicuous. However, on the main moorland area, their surveyors recorded Red Grouse in 483 one- kilometre squares (Brown & Shepherd, 1991), where Yalden (1972) found them in 497 of their survey squares, as well as in a further 6 squares that they did not cover; Yalden (1972) also reported traces, but no grouse seen, in a further 22 squares. On the main moors of the Peak District, the distribution and perhaps abundance of Red Grouse is little changed; certainly they seem to be about 4 times more abundant there than on the peripheral moors, from the timed counts.

Failure to detect Red Grouse in 41 peripheral squares during this survey, compared with only 10 such failures around 1970, is certain evidence for the decline of the species on peripheral moors, for all these recent visits were made at a time of year when Red Grouse are readily detectable. Though the numerical comparisons are open to argument, they also indicate very strongly a similar decline; Red Grouse are both less widely distributed on these peripheral moors, and less numerous even where they still occur.

These small moors have a landscape as well as a biological importance which is much greater than their area alone would suggest; the only surviving Black Grouse in the Peak District are on and around the south western moors, which also hold good populations of Curlew and other characteristic species. The cases of the few moors where increases have occurred show that the overall trend documented here is reversible. The inclusion of various of these areas within Environmental Sensitive Areas, SSSIs and within the Peak Park itself ought to ensure that, indeed, the reverse trend will be revealed over the next 20 years, but it will require much attention to details, and much collaboration between farmers, landowners, planners and government agencies to ensure that it does.

REFERENCES

Brown, A. F. and Shepherd, K. (1991) Breeding birds of the south Pennine Moors. Joint Nature Conservation Committee Report Number **7**: 1-81.

Yalden, D. W. (1972) The Red Grouse (*Lagopus lagopus scoticus* (Lath.)) in the Peak District. *Naturalist* **97**: 89-102.

Yalden, D. W. (1979) An estimate of the number of Red Grouse in the Peak District. *Naturalist* **104**: 5-8.

BOOK REVIEWS

Butterfies Through Binoculars. A Field Guide to Butterflies in the Boston – New York – Washington Region by **Jeffrey Gassberg**. Pp. 160 + 40 pp colour plates. Oxford University Press. 1993. $19.95

This is an American paperback which provides an entirely adequate coverage for identifying all butterflies to be found in these important eastern seaboard States, and without any collecting or even catching! Binoculars need to be appropriate, with close focussing possible down to 12 feet or less. Excellent photographs of all the species have been taken which have both a sharp clarity and an aesthetic appeal. Critical points of distinction have been highlighted. Over a handful of the 158 species described are to be found in the British Isles. The order of families follows that of earlier traditional works, thus the "Swallowtails" (8 species) are first and the "Skippers" are last. That there are only 4 "Blues" is some relief when compared with the difficulty one can have with over 70 included in the European classic by L. G. Higgins and N. Riley. However the "Skippers" are the difficult ones, with 58 Hesperiidae in this American list. Scientific and English names are given; however, the former do not include the names of the original authority. Synonymy could occur between some Palaearctic and Nearctic species. One species described as *Coenonympha tullia* appears to be our *Coenonympha pamphilus* Linnaeus.

The producers of this book are to be congratulated and any visitors to this part of the USA with time and opportunity to observe butterflies will be well served by this volume. However, at 1lb, it could be a little heavy on the pocket; yet any reduction in size would limit this total survey.

PGT

Plants in Hawaiian Culture by **Beatrice H. Krauss**, and illustrated by **Thelma F. Greig**. Pp. x + 345, including numerous line drawings and 98 full-page b/w plates. University of Hawaii Press. 1993. $26.95 paperback.

Although there may be few British readers of *The Naturalist* who will have the opportunity to visit Hawaii, nevertheless through television, botanical garden hot-houses and ethnobotanical collections in museums the contents of this book will appeal to a wider readership than might initially be expected. An interesting text supported by copious illustrations shows how the plants of 'pre-contact' Hawaii have been utilized for a wide range of purposes. The Polynesian settlers brought economic and social practices which were modified and changed as a result of time, isolation and local conditions. The relatively small but rich native flora, however, satisfied many of the settlers' needs in terms of food, medicine, garments, houses and canoes, as well as furnishing materials used in fishing, games and sports, war, religion and burial. Food plants were mainly introduced by the Polynesians, probably including taro, sweet potatoes, breadfruit, yams, banana, coconuts and sugarcane, although some of these may have been brought in by other settlers.

The book provides a fascinating insight into island culture, but it is not apparent which

(and how extensively) particular practices continue to this day; nor is information provided on the extent of the plant resources or their conservation, which are important in understanding the value in maintaining biodiversity. Despite this criticism, this book will be enjoyed by many, particularly those interested in ethnobotany, economic botany, island culture and biogeography.

MRDS

Atlas of the Bryophytes of Britain and Ireland. Volume 1 Liverworts (Hepaticae and Anthocerotae). Volume 2 Mosses (except Diplolepideae). Volume 3 Mosses (Diplolepideae). Edited by **M. O. Hill, C. D. Preston** and **A. J. E. Smith**. Pp.351, 400 and 419. Harley Books. 1991, 1992, 1994. £27.50 (Vol 1), £30.00 (Vol 2), £32.50 (Vol 3), hardback.

This three-volume set is the culmination of the British Bryological Society's Distribution Maps Scheme, launched as long ago as 1960. Occasional maps appeared in the *Transactions of the British Bryological Society* and the *Journal of Bryology* between 1963 and 1978, and a *Provisional Atlas* of selected species was published in 1978. Now at last the full work is available. As the British Isles is one of the richest areas in Europe for bryophytes, with communities of international importance, many will feel that its appearance is long overdue.

Each volume contains an introductory chapter. In volume 1 there is an account of the "History of Bryophyte Recording in the British Isles", by C. D. Preston, together with a brief account of the BBS Mapping Scheme. Volume 2 has an account of the "The bryophytes of Britain and Ireland in a European context" by A. C. Crundwell; some of the comments are unfortunately already out of date: the supposed endemic species *Fissidens celticus* and *Anoectangium warburgii*, for example, are now known to occur outside the British Isles. The final introductory chapter, in volume 3, is "A numerical analysis of the distribution of liverworts in Great Britain" by M. O. Hill and F. Dominguez Lozano.

The maps are produced one to a page and use the conventional closed and open circles to mark occurrences. Open circles are used for records dated before 1950. It is acknowledged, however, that for various reasons there are some anomalies in the dating of records. This does not affect the overall picture. Sometimes, the maps show the bias of recording in certain areas (or the lack of it in others), but national patterns are clear and for most species the distribution is reasonably complete. In the second and third volumes double circles and arrows have been used to highlight isolated dots, but this is not so in volume 1. Some dots, therefore, are difficult to locate on the liverwort maps, and are easily overlooked.

Each map is accompanied by explanatory notes, generally outlining the habitats of the species in the British Isles, their reproductive characteristics, and their European and worldwide distributions. These notes have been written by various contributors and there is some unevenness in their content, but they are an excellent feature of the *Atlas* and will increase its usefulness enormously for conservation workers and non-specialists. Maps (but not overlays) of environmental factors are reproduced in volume 1.

This is an excellent and well-produced work which is a tribute to the dedication of the small number of active bryologists in the British Isles. Unfortunately the high combined price of the three volumes may well deter all but enthusiasts from obtaining it.

TLB

THE DEVELOPMENT OF PULFIN

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INTRODUCTION

Pulfin is a piece of marshy land in the Hull valley, 2km north of the A1038 road to the east of Beverley, Humberside (TA 050440). It is bounded on the east by a shallow drain from rising ground and on all the other sides by a meander of the River Hull. It covers about 15 hectares, encloses several springs and has been considered to be one of the few remnants of the carr lands (Woodhead, 1920) which were once extensive in the Hull valley (Sheppard, 1958). It was designated a Site of Special Scientific Interest (SSSI) by the Nature Conservancy Council in 1954. Before being given to the Yorkshire Wildlife Trust as a nature reserve in 1980, its continued, undeveloped state was most likely due to its action as a safety valve on the river. During the winter months much of Pulfin may be inundated with flood water which spills in over the low banks to the north, preventing the river over-topping in more critical areas downstream.

Apart from the rather regular shape, Pulfin shows every sign of being an undisturbed relic of the ancient Hull valley marshes. It still supports some of the rarer marsh plants such as marsh pea (*Lathyrus palustris*) and marsh fern (*Thelypteris palustris*). During the 1950s, when the area was still grazed by cattle, early marsh orchid (*Dactylorhyza incarnata*), bog bean (*Menyanthes trifolia*), marsh cinquefoil (*Potentilla palustris*), marsh lousewort (*Pedicularis palustris*) and the fibrous tussock sedge (*Carex appropinquata*) were still present (Crackles, 1954, 1990). During researches prior to the preparation of a management plan for this reserve (Middleton, 1987), it became apparent that Pulfin had only existed in its present form for two centuries. This change has subsequently been noted by Allison (1989).

HISTORY

The earliest known record of the name as "Polefen", meaning "Pool Fen", is found in documents of 1334 (Allison, 1989). Although many early maps are rather stylised, the sharply angled, four sided shape of this river bend is quite characteristic and would be expected to be represented as such. The earliest map seen which shows the river clearly is that of Osborne (1668). Here the bend is shown as a triangular shape, the short side being on the north. Tate's 1764 plan is somewhat stylised but clearly shows a triangular meander. Tuke's 1786 map of Holderness again shows a similar form. This shape is shown, much more convincingly, on Bower's 1 inch to 33 chains map of 1781 (figure 1a). This map is finely detailed and surprisingly accurate with only a little angular distortion. In addition to the shape of the river it also shows a drain crossing the loop. This drain corresponds precisely in shape and position with the eastern boundary of the marshy area.

Jessop's 1800 plan of the proposed Leven canal shows the river loop in its present form and labels the land to the east "Pulfins". Although Smith's map of 1801 is somewhat stylised, it seems to show a modern shape; both Carey's 1808 map and Bryant's 1829 map show Pulfin within an over-large, but obviously square meander. Byrant labels the marsh "Pulfin Hole". Stickney's 1833 survey of the township of Eske also shows the present form and names it "Pulfin", with an area given as 30 acres, 1 rood and 32 perches. The first 6" to 1 mile map produced by the Ordnance Survey in 1855 shows the present form in fine detail and labels the north west corner as "Commonbank Nook" (figure 1b). There are several drainage ditches shown connecting the springs to the river. Two of the central springs are seen to be fenced off, presumably to prevent livestock drowning in these deep pools.

There was much plagiarism among early map-makers but it does seem likely that a major diversion of the river was made sometime between 1781 and 1800, as both Bower's and Jessop's maps are based on accurate survey work. If this is indeed the case, it implies

FIGURE 1
(a) Detail from Bower's plan of 1781.
(b) Detail from OS sheet 196, 1855 at the same scale and orientation.

that the old course of the river is now contained within an enlarged loop and that much of the present fen was once on the western side of the river.

TABLE 1
Sediment analyses

	1	2	3	4	5	6
SiO_2	53.21	54.06	49.16	47.15	54.06	53.85
Al_2O_3	19.77	16.26	13.40	14.76	18.26	17.49
TiO_2	0.91	0.86	1.03	1.18	0.92	0.87
Fe_2O_3(t)	7.01	6.24	7.38	7.95	6.51	5.25
MnO	0.06	0.08	0.15	0.15	0.06	0.06
MgO	2.13	2.44	2.08	2.27	2.91	2.75
CaO	2.86	2.27	6.72	6.32	1.64	1.54
Na_2O	0.40	0.45	0.41	0.38	1.80	1.64
K_2O	2.84	2.73	2.12	2.36	3.18	3.05
P_2O_5	0.17	0.16	0.77	0.78	0.19	0.16
SO_3	0.25	2.97	0.56	0.64	1.32	4.81
Rb	131	124	94	102	132	123
Cr	129	111	180	190	131	109
Zn	152	133	333	371	112	110
Cu	23	21	60	63	22	20
A	26	22	48	59	19	20
Nb	19	17	30	37	20	19
Pb	31	29	141	163	29	31

Sediments analysed by X-ray fluorescence spectrometry at the University of Hull. Major element oxides determined on fusion beads by the method of Norrish and Hutton (1969). Minor elements determined on pressed powder pellets. Analyses made on oven dried material, concentration of major element oxides in weight percent and minor elements as $\mu g.g^{-1}$. Total iron expressed as Fe_2O_3.

1 & 2 Auger samples from Pulfin; 3 & 4 Sediment from the river at Hull Bridge (TA 055419); 5 & 6 Ancient Humber muds, Easington (TA 411184).

Although it seems strange to make such a major diversion to the course of the river, there were many reasons why it may have been considered worthwhile. Records of the Court of Sewers for eastern East Yorkshire show that the river was in a very poor state at the end of the eighteenth century. In 1787 the Court commissioned Mr Jessop to report on the ". . . best mode of making a compleat navigation and drainage, and particularly what will be the expense of executing such works . . . ". When reporting back the following year, he stated that the obstructions in the River Hull appeared to him "to have accumulated in a course of years to a degree beyond anything he had seen elsewhere" (Court of Sewers, 1789). Soon after this there was a great deal of engineering activity in this part of the Hull valley. The Beverley and Barmston Drain, which runs closely parallel to the west bank of the river for about 400m, was constructed around 1800 and the Leven Canal, entering the river 1km upstream of Pulfin, opened in 1802.

Pulfin was at the southern end of extensive carr lands belonging to the manors of Arram and Leven. Arthur Young (1798) described how in 1797 he stood on the eastern bank of the Hull and looked across at the "horrid watery wastes" of Arram Carr "producing nothing but fish, frogs, wild-ducks, and dumbles for horse collars". Crackles (1988) considers the "dumble" to be the Lake Club-rush (*Scirpus lacustris*). Several springs rise in the vicinity,

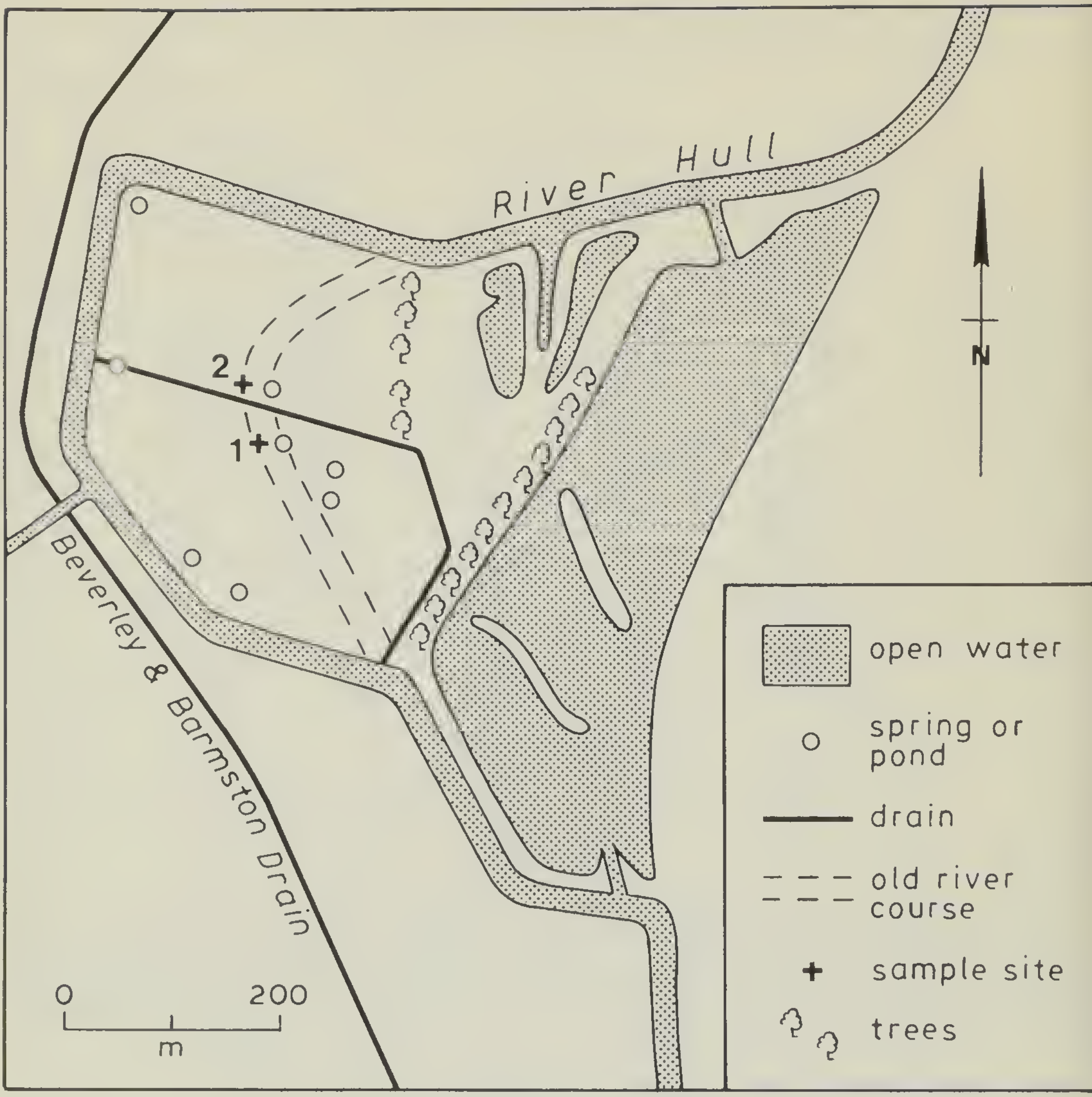

FIGURE 2
Sketch map of Pulfin showing the sampling sites and the course of the River Hull from Bower's map of 1781.

the water from which finds its way into the river by percolation and small streams. In order to provide a firm and stable course for the proposed new Barmston Drain, it may have seemed attractive to divert the river around these springs to join Arram Beck above its original outfall. The river would then continue eastwards along the beck bed to join its old course 200m downstream. It is known that a new outfall to the navigable Arram Beck was made around 1797 (Kent, 1979) and it may be that this was part of the larger works which created Pulfin. The eastern bank of the Hull is lower than the west and the spring water easily drains away into the river. This would have simplified the construction of the Beverley and Barmston drain and probably improved the navigation for the anticipated increase in river traffic.

This hypothesis is supported by the presence of several springs only a few tens of metres from the east river bank. The most notable and constant of these is the spring in the north west corner of the reserve. It is probably this one which was instrumental in dictating the unusually sharp bend in this region. This is the corner designated "Commonbank Nook" on the Ordnance Survey map, which rather suggests an area created by banking. It seems

likely that Pulfin's east–west drain was constructed at this time to lead away the water from the central springs.

Sediment Chemistry

In 1992 an exploratory peat boring near the southernmost of the central springs encountered a grey, plastic clay at about 3m below the marsh surface. During 1993 a further sample of grey clay was obtained, at a depth of 4m, while augering to the west of the main central spring (figure 2). Holes bored 30m and 60m eastwards had proved peat down to 5m. In certain other parts of the fen the peat thickness is known to exceed 5m (Dr D J Boatman *pers. comm.*). The pale appearance of the clay suggested initially that it might be marly in composition. It was thought that it may have been brought up by springs and represent material derived from the Chalk. Subsequent chemical analysis of this material (table 1, samples 1 & 2) has shown the clays are rather depleted in calcium but otherwise rather similar in major element composition to modern sediments taken from the River Hull nearby (table 1, analyses 3 & 4). Their grey colouration may be accounted for by the reduction of the iron oxides as entrained organic matter decayed. Indeed, several months exposure to the atmosphere turned the sediment to a rich brown colour. The high sulphur content of the clays probably also originates in organic material. It seems certain that these grey clays represent sediments deposited on the River Hull bed prior to its diversion almost two centuries ago. These two samples also show a marked similarity in bulk composition to samples taken from the *Scrobicularia* clays exposed on the shore at Easington, N. Humberside (table 1, 5 & 6). These sediments represent muds deposited in a tidal creek by a pre-industrial river Humber (Bisat 1952).

Levels of chromium, copper, zinc, arsenic, niobium and lead correspond closely with those recorded in pre-industrial Humber sediments (Middleton & Grant 1989) and analyses 5 & 6 in table 1, further supporting a river sediment origin for these grey clays. This contrasts markedly with the modern river sediments which now show elevated levels of all of these metals due to discharges of domestic and industrial waste into the Hull and Humber. The elevated levels of niobium suggest that much of this extra heavy metal load originates in the estuary, as the main sources of niobium contamination are the titanium dioxide industries on the south bank of the lower Humber. The River Hull is still tidal at Pulfin but its distance from the sea makes the rise and fall of the water somewhat asymmetrical, with a longer ebb than flow. The rising water will tend to move faster and carry more material in suspension, some of this being deposited at periods of slack water. This results in a net influx of sediment from the Humber.

Interestingly, the level of the important nutrient element phosphorus is also much lower in these buried sediments than their modern counterparts. Large quantities of phosphorus are discharged into the river and estuary from both sewage treatment plants and fish farms. This indicates that the annual winter flooding of Pulfin is now distributing sediments over the marsh which contain greatly elevated nutrient levels. This, coupled with the currently elevated nitrogen levels in both the river and ground-water, will provide a much richer medium for plant growth than was the case in historical times. It is more difficult to predict the effects of increased heavy metal levels in the sediment. The concentrations may still be too low to present a toxic threat to plants but they may be sufficient to give certain, more resilient, species a competitive edge over the more sensitive.

Future Development

During the last few years water management has become increasingly important. Summer droughts and increased groundwater extraction have seriously lowered the water-table. The *Phragmites*, which once dominated south of the central drain, has failed to make good growth and is being ousted by other species. Efforts have been made to retain as much of the spring and flood water as possible but it is certainly richer in nutrients than it was originally. This can be seen by the algal mats which often form in the areas of open water. Disturbed land is usually colonised by nettles (*Urtica dioica*).

In 1989 a borrow pit to the east of the reserve, almost the same area as Pulfin, was flooded to create a lake. It cut off the loop of the river and isolated the reserve plus an area of rough grassland, old borrow pits, scrub and trees, from casual disturbance. This large and varied area now provides an ideal habitat for many species of mammal and bird. Fox and roe deer are known to be present on the reserve. Recent work (Kirk, 1993) has shown that both bank and short-tailed vole are present as well as common, pigmy and water shrew. The harvest mouse has been recorded in the area of the reserve (Howes, 1985) and it seems likely that it may still be present in this undisturbed habitat.

The reduced water levels, loss of grazing and increased nutrient levels mean that although even the most aggressive management regime will never be able to return this land to its previous botanical state, it is still a valuable wildlife habitat. It may be necessary to accept that it will not be possible to recreate or even maintain the plant communities which once existed here and that it is more realistic to accept the change and direct management towards the maintenance of a varied habitat. Whatever the way in which it develops, its size, position and relative isolation will ensure that it has the potential to remain an important wildlife habitat. The inevitable changes will also provide an interesting opportunity to observe the processes of competition and colonisation.

Acknowledgements

Thanks are due to Dr D. J. Boatman and Mr B. R. Kirk for assistance with augering and for many long and thought-provoking discussions regarding the past, present and future of Pulfin. Sediment samples 3 & 4 were collected by Mr S. Nelms and the map was drawn by Mr K. Scurr.

References

Allison, K. J. (1989) Arram. In (K. J. Allison ed.). *Victoria History of the County of York, East Riding*. Volume 6. Oxford University Press, Oxford.

Bisat, W. S. (1952) Post-glacial peat and *Scrobicularia* clay near Easington, Yorkshire. *Trans. Leeds Geol. Assoc.* **6**: 210-214.

Bower, A. (1781) A plan of the Holderness drainage, scale 1": 33 chains.

Bryant, A. (1829) Map of the East Riding of Yorkshire, scale 1": 1 mile.

Cary, J. (1808) A new map of Yorkshire, scale 1": 2¾ miles.

Court of Sewers, (1789) Report of the Court of Sewers for the east parts of the East Riding of Yorkshire relating to the dressing and cleansing of the river Hull. (University of Hull Archives DDCV(2)/80/4).

Crackles, F. E. (1954) Pulfin Bog. Report on features of botanical interest. Unpublished report to NCC (now English Nature), York.

Crackles, F. E. (1988) Dumbles. *East Yorkshire Local History Society Bulletin* **38**: 15-18.

Crackles, F. E. (1990) *Flora of the East Riding of Yorkshire*. Hull University Press, Hull.

Howes, C. (1985) The Harvest Mouse. In (M. J. Delany ed.) *Yorkshire Mammals*, University of Bradford, Bradford.

Jessop, W. (1800) Plan of part of the Township of Leven and places adjacent describing the intended canal. (University of Hull Archives DDCV/100/5).

Kent, G. H. R. (1979) Leconfield. In (K. J. Allison ed.). *Victoria History of the County of York, East Riding*. Volume 4. Oxford University Press, Oxford.

Kirk, B. R. (1993) Small mammals at Pulfin. Hull Natural History Society, Information Sheet no 2. Hull.

Middleton, R. (1987) Appendix 1 – The development of Pulfin Fen. In (D. J. Boatman). *Pulfin management plan*. Unpublished report, Yorkshire Wildlife Trust, York.

Middleton, R. and Grant, A. (1989) Heavy metals in the Humber estuary: *Scrobicularia* clay as a pre-industrial datum. *Proc. Yorks. Geol. Soc.* **48**: 75-80.

Norrish, K. and Hutton, J. T. (1969) An accurate X-ray spectrographic method for the analysis of a wide range of geological samples. *Geochim. Cosmochim. Acta* **33**: 431-453.

Ordnance Survey (1855) Map: sheet no. 196, scale 6": 1 mile.

Osborne, J. (1668) Map: description of the River Hull, scale 1": 4 miles.

Sheppard, J. A. (1958) *The Draining of the Hull Valley*. East Yorkshire Local History Society, York.

Smith, C. (1801) A New Map of Yorkshire., scale 1" = 2½ miles.

Stickney, R. A. (1833) Map: township of Eske. (University of Hull Archives DDCV/165/6)

Tate, C. (1764) Map: Holderness, scale 1": 64 chains.

Tuke, J. (1786) Map of Holderness, scale 1": 1¼ miles.

Young, A. (1798) Holdernesse–Beverley–Hull, some notes in 1797. *Annals of Agriculture*, **31**: 113-264. Reproduced in J. Crowther (ed.) 1992. *Descriptions of East Yorkshire: de la Pryme to Head*. East Yorkshire Local History Society, Beverley.

RECORDER'S FIFTH REPORT ON THE ACULEATE HYMENOPTERA IN WATSONIAN YORKSHIRE

THE DEVELOPMENT OF A DECADE 10 KM. SQUARE RECORDING SYSTEM AND THE COMPUTERIZATION OF RECORDS

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NEW AND RARE SPECIES

The following two species are recorded from Yorkshire for the first time. *Priocnemis hyalinata* (Fabricius, 1793) was found at Blaiskey Bank (VC 62, SE 68, July 1991, female, A. Grayson). Previously known to southern Lincolnshire, this record represents a northern extension (Day, 1988). In the past this species has been confused with *P. fennica* Haupt, 1927. *Nomada flava* Panzer, 1798 was found at Lindrick Dale Quarry (VC 63, SK 58, May 1993, female, M. E. Archer). Archer (1993) predicted that this species might be found in South Yorkshire.

By December 1993 the Watsonian Yorkshire list of aculeate Hymenoptera consisted of 308 species.

The 15 rarities which follow have been recorded recently. Collectors are identified by initials: M. E.Archer (MEA), J. D.Coldwell (JDC), R. Shaw (RS), D. Sheppard (DS). The initials, vice-counties and grid references of the localities are: BC (Blaxton Common, VC 63, SE 60), LDQ (Lindrick Dale Quarry, VC 63, SK 58), MC (Manvers Colliery, VC 63, SE 40), RB (Rossington Bridge, VC 63, SK 69), SCC (South Cliff Common, VC 61, SE 83).

Cleptes semiauratus (Linnaeus, 1761). MC (June 1993, JDC).

Episyron rufipes (Linnaeus, 1758). BC (Aug. 1991, JDC), SCC (June 1992, July 1993, MEA), RB (July 1992, MEA), Barnaby Dun (VC 63, SE 60, July 1992, MEA).

Crossocerus palmipes (Linnaeus, 1767). BC (Aug. 1993, MEA).

Psen lutarius (Fabricius, 1804). SCC (July 1993, MEA).

Spilomena beata Bluthgen, 1953. Hugset Wood (VC 63, SE 30, July 1992, JDC).

Pemphredon morio Van der Linden, 1829. MC (July 1993, JDC).

Diodontus luperus (Shuckard, 1837). Shirtcliff Wood (VC 63, SK 48, July 1991, RS), BC (Aug. 1991, JDC), Rossington Bridge (July 1992, MEA).

Nysson dimidiatus Jurine, 1807. BC (Aug. 1991, JDC), MC (June 1992, JDC).

N. trimaculatus (Rossius, 1790). MC (June 1992, JDC).

Argogorytes fargei (Shuckard, 1837). Keswick Fitts (VC 64, SE 34, July 1993, MEA). The main nesting site at Keswick Fitts has been destroyed by new embankment works.

Colletes halopilus Verhoeff, 1943. Welwick saltmarsh (VC 61, TA31, Sept. 1991, DS).

Andrena ocreata (Christ, 1791). LDQ (July 1993, MEA).

Specodes crassus Thomson, 1870. Stutton (VC 64, SE 44, June 1993, M.E.A.).

S. ferruginatus von Hagens, 1882. LDQ (Aug. 1992, MEA).

S. puncticeps Thomson, 1870. Cave Wold (VC 61, SE 93, July 1993, MEA).

A RECORDING SYSTEM FOR SOCIAL WASPS (VESPIDAE)

Normally a record would be based on a specimen differing in one of the three variables: name, sex, day of observation. Such records may be considered as the traditional recording system. Because the number of such records of the social species tend to be numerous it is useful to use a different system to reduce the work load.

A decade 10km sq. record is based on a specimen differing in one of the three variables: name, decade when and 10km sq. where observed. Watsonian Yorkshire may be considered to include, at least in part, 195 10km squares. By February 1993, 801 decade 10km sq. records had been collected (Table 1). The ten decades of the twentieth century are separated but the decades of the nineteenth century are grouped together. The commonest species is *Paravespula vulgaris* (Linnaeus, 1758) (29.6% of the records, present in 72.3% of 10km sq.) and the rarest species *Vespa crabro* Linnaeus, 1758 (1.0% of the records, present in 3.6% of 10km sq.). Most records are from the 1970s when I was actively collecting records for the National Recording Scheme. A small peak of records was present during the 1920s.

TABLE 1
The number of decade 10km records of the social wasps (Vespidae) of Watsonian Yorkshire.

	Pre-1900	1900s	1910s	1920s	1930s	1940s	1950s	1960s	1970s	1980s	1990s	Total	No. km sq
Vespa crabro	1	2	0	0	0	0	1	0	0	3	1	8	7
Vespula austriaca	0	3	1	3	0	0	0	0	10	7	3	27	21
Vespula rufa	0	2	6	14	4	4	6	8	56	38	11	149	92
Dolichovespula norwegica	0	4	6	6	6	2	6	3	38	20	6	97	75
Dolichovespula sylvestris	0	2	10	11	7	1	5	3	53	43	12	147	89
Paravespula germanica	0	3	6	5	2	3	2	4	89	16	6	136	99
Paravespula vulgaris	0	5	12	11	6	6	9	9	122	41	16	237	141
Total	1	21	41	50	25	16	29	27	368	168	55	801	

COMPUTERISATION OF RECORDS

A start has been made on computerising records, using the software dBASE IV, beginning with the mason wasps (Eumenidae). My database is only concerned with primary records (Archer, 1987) including the basic part of the record (genus, species, sex, locality), derived part of the record (lkm & 10km squares, VC), and the historical part of the record: collector, determiner, confirmer, source (i.e. from the literature, museum or private collections).

The immediate benefits of the computerised database are to make the records more readily available, and to carry out analyses which would not have been carried out previously because of the amount of work involved.

Up to February 1994 there were 617 records (from 13 species) of Eumenidae. The records were from 214 localities and the top four localities were Heworth, York (37 records, 5 species), Spurn (33, 6), Allerthorpe Common (26, 6) and Burton Leonard Lime Quarries (20, 6). The surveys of Allerthorpe Common extend over the period from 1901 until the present. Notable collectors were W. J. Fordham, J. Wood, R. Butterfield, W. D. Hincks and M. E. Archer. The work at Spurn was mainly carried out between 1947 and 1952 by W. D. Hincks and S. Shaw. Work at Heworth, York and Burton Leonard Lime Quarries has been carried out recently by M. E. Archer.

Records are known from 94 10km squares (48% of possible squares) and 205 1km squares, so coverage of Yorkshire is reasonably good (Archer, 1982). The top four 10km squares are SE 74 (43 records, Allerthorpe Common and Barmby Moor), SE 65 (40, York area), SE 04 (39, Keighley district and Holmehouse Wood) and TA41 (33, Spurn). The records from Barmby Moor were collected by W. J. Fordham from 1927 to 1937. This locality has almost disappeared, mainly due to agricultural changes. The records from Holmehouse Wood are from two periods: 1909-1944 (J. Wood and R. Butterfield) and 1988-1992 (M. E. Archer). A comparison of the aculeates of this woodland, for these two periods separated by 50 years, will soon be possible.

The number of records in decade intervals are given in Table 2. Most records are from the twentieth century (97.9%) with an increase in the numbers of records in recent decades, and a possible reduction during the 1950s and 1960s.

Table 3 shows the months in which records were made. June and July are the best months for surveying adult mason wasps.

Table 4 shows the sources of records with 13.1% from published and unpublished literature, 48.8% from private collections and 37.9% from museum collections. The most important museums are those at Keighley and Manchester. Yorkshire material has been found in museums in Oxford and London. The importance of records from private collections is clearly indicated.

The collectors of 59 records (9.6%) are unknown. The eight most important collectors and their years of activity are given in Table 5. We have been lucky in that an interest in mason wasps has been present from the nineteenth century. The nineteenth century collectors were W. J. Fordham, E. Saunders, F. Smith and E. E. Thoyts. F. Smith was the father of the study of Yorkshire aculeates collecting at Woolley, near Wakefleld; W J. Fordham lived in Frog Hall a house next to Allerthorpe Common; E. Saunders, who lived in southern England, produced a book with the first complete keys to British aculeates (Saunders, 1896). There is no further information on E. E. Thoyts, except that he collected in the Whitby district and his specimens are in the Oxford museum.

The concept of a "local" species

The term "local" seems to have at least two meanings. "Local" species are more usually considered to be those restricted to a particular habitat type, or geographical region (S. Ball, personal communication, 1993). Archer (1993) defined the term "local" as a species having relatively more records from relatively fewer localities, i.e. a higher "no. of records/no. of localities" index. The cut-off point on such an numerical index is based on personal experience.

In applying the Archer index some species which are common, e.g. *Lasioglossum rufitarse* (Zetterstedt, 1838), come out as "local" because they have a long adult life cycle. This is clearly wrong. Common species with a long adult life cycle should therefore be withdrawn.

Rare species which may or may not be local in their distribution and thus may or may not be isolated with the Archer index also should be withdrawn. Rare species need to be considered as a separate category (Archer, 1993).

TABLE 2

The distribution of records of mason wasps (Eumenidae) from Watsonian Yorkshire during the nineteenth and twentieth centuries.

Date	No. of records
Pre-1900	13
1900s	23
1910s	55
1920s	42
1930s	52
1940s	63
1950s	22
1960s	18
1970s	114
1980s	140
1990s	75
Total	617

TABLE 3

The distribution of 542 records of mason wasps (Eumenidae) from Watsonian Yorkshire during the months of the year.

March	April	May	June	July	August	September	October
0	1	19	227	202	78	15	0

TABLE 4

The sources of 617 records of mason wasps (Eumenidae) from Watsonian Yorkshire.

Source	No. of records
Doncaster Museum	8
Keighley Museum	68
Leeds Museum	4
London Museum	27
Manchester Museum	64
Oxford Museum	3
Rotherham Museum	18
Scarborough Museum	6
Sheffield Museum	35
York Museum	1
Total Museums	234
Private Collections	301
Literature	81
Unknown	1

TABLE 5
The eight most important collectors of mason wasp (Eumenidae) records from Watsonian Yorkshire with dates when they were most active.

Collector	No. of records	Years of activity
M. E. Archer	144	1969-1993
R. Butterfield	36	1907-1935
J. D. Coldwell	26	1985-1993
J. H. Flint	21	1947-1989
W. J. Fordham	30	1917-1937
A. Grayson	23	1989-1990
W. D. Hincks	49	1942-1971
J. Wood	28	1923-1947

Withdrawal of rare species and common species with long life adult cycle from the species isolated by the Archer index leaves 13 solitary wasp and 14 solitary bee species which may be considered to have a local distribution in Watsonian Yorkshire. In practice these species appear to be almost entirely restricted to sandy habitats.

REFERENCES

Archer, M. E. (1982) The Mason Wasps (Hymenoptera: Eumenidae) of Yorkshire. *Naturalist* **107**: 5-13.

Archer, M. E. (1987) The activities of a Recorder of the Yorkshire Naturalists' Union – the Aculeate Hymenoptera, in Conference on Records and Recording at Leeds University: 5-8.

Archer, M. E. (1993) Recorder's fourth report on the aculeate Hymenoptera in Watsonian Yorkshire and the development of a quality scoring system. *Naturalist* **118**: 13-15.

Day, M. C. (1988) Handbooks for the Identification of British Insects. Spider Wasps Hymenoptera: Pompilidae. 6 (4). Royal Entomological Society of London.

Saunders, E. (1896) *The Hymenoptera Aculeata of the British Isles*. Lovell Reeve, London.

Y.N.U. BRYOLOGICAL SECTION: ANNUAL REPORT 1992-1993

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Sectional meetings during 1992-1993 have been held as follows:

Spring 1992	– Rishworth and Cragg Vale (VC 63), 2 May
Autumn 1992	– Flasby (VC 64), 19 September
Spring 1993	– Hayburn Wyke (VC 62), 8 May
Autumn 1993	– Force Gill, Whernside (VC 64), 2 October

These are reported in the Bulletin of the Yorkshire Naturalists Union.

There was also an excursion to Hackfall Wood (VC 64) during the Autumn Meeting of the British Bryological Society in Ripon on 19 September 1993. A long list of species was

compiled, and a new station discovered for the hepatic *Hygrobiella laxifolia* in the vice-county. A full account has been prepared elsewhere (Blockeel, 1994).

RECORDS

Records during the past two years have been rather sparse and scattered, but Mr. J. M. Blackburn has continued to do some excellent recording in the Cleveland area. The most interesting trend in records is the evident re-colonisation of lost ground by certain epiphytic species which disappeared when levels of SO_2 pollution were high. *Frullania dilatata, Ulota bruchii, U. phyllantha* and some *Orthotrichum* species appear to be the most affected, but additional species might be expected to recur. For example, the moss *Cryphaea heteromalla*, only recently refound in north-west Yorkshire (Blockeel, 1984), has now been recorded on Elder near Dore on the outskirts of Sheffield (leg. TLB, Nov 1992). This locality is just outside Watsonian Yorkshire, in VC 57.

The most remarkable recent discovery has been that of a new species of moss, *Thamnobryum cataractarum*, at Twisleton Glen, Ingleton. This species is closely related to a Madeiran endemic, *T. fernandesii* and is also similar to the Derbyshire species *T. angustifolium*. The new species is clearly a relict of an ancient group, and it grows as an aquatic by swift water. A full description and report can be found in Hodgetts and Blockeel (1992).

The list below includes all new vice-county records and other records of note. Recorders initials: JMB = J. M. Blackburn, TLB = T. L. Blockeel; PCB = P. C. Bowes; OLG = O. L. Gilbert; CW = C. Wall. An asterisk indicates a new vice-county record or an amendment to the *Census Catalogue*.

Kurzia pauciflora: (62) 44/89 Soak on bog, Fen Bog, JMB, April 1992.

Scapania compacta: (64*) 34/67 Among Ingletonian rocks, above Pecca Falls, Ingleton, TLB, August 1992.

Cephalozia macrostachya: (62) 44/89 on *Sphagnum*, Fen Bog, PCB, 1992.

Frullania dilatata: (63*) 44/31 on *Salix* in wet ground, Newmillerdam, near Wakefield, TLB, May 1992; 43/38 On Sycamore, Ecclesall Wood, Sheffield, OLG, April 1993; (64) 44/44 On *Salix*, Cock Bridge, Stutton, TLB, April 1992. The records for VC 63 are apparently the first since *c.* 1880.

Sphagnum warnstorfii: (64*) 34/86 Malham Tarn West Fen, M. C. F. Proctor, August 1990. Refound during the visit of the Y.N.U. in May 1993.

Andreaea rupestris: (62) 45/61 On sandstone rock by Tidkinhow Slack, JMB, March 1992. Second recent record for the vice-county.

Oligotrichum hercynicum: (62) 44/89 On damp peaty soil, Fen Bog, PCB, September 1991.

Seligeria recurvata: (63) 44/21 On sandstone of bridge parapet, Bretton lakes, TLB, June 1993.

Leucobryum glaucum: (63) 43/38 Ecclesall Wood, Sheffield, OLG, April 1993. Mrs. Joan Egan tells me that she too knows this species in Ecclesall Wood. The only other recent record for VC 63 is from Lothersdale in the north-west of the vice-county.

Fissidens taxifolius spp. *pallidicaulis*: (63*) 44/01 In dripping rock crevices on steep bank by stream, 200 m alt., Turner Wood, Rishworth, TLB, May 1992. This subspecies is not very well-defined in Britain. Most plants of this species from rock crevices in the Pennines are rather larger and have more tapered leaves than the common form from woodland soil.

Tortula freibergii: (62*) 54/09 On sandstone boulders at top of beach, Hayburn Wyke, F. J. Rumsey, January 1992 (Rumsey, 1992). Refound on several boulders during the Bryological Section Meeting in May 1993; 45/61 Vertical face of large sandstone rock in Skelton Beck, *c.* 75 m alt., Upleatham, JMB, May 1993. This rare species was previously known only from the vicinity of Fairlight in Sussex, and from canal banks in the Greater Manchester district.

Aloina aloides: (62) 44/86 Spoil heaps, Newbridge Quarry, Pickering, PCB, August 1992.

Pottia recta: (64) 44/44 Edge of in-filled Magnesian Limestone Quarry, Cock Bridge,

Stutton, TLB, April 1992.

Phascum curvicolle: (64) 44/44 Edge of in-filled Magnesian Limestone Quarry, Cock Bridge, Stutton, TLB, April 1992.

Barbula nicholsonii: (63) 44/22 On small boulder by stream, Oakwell Hall, Birstall, TLB, August 1992. A surprising record in the heart of the West Yorkshire conurbation; previously recorded in VC 63 only from the R. Aire near Skipton.

Weissia microstoma var. *brachycarpa*: (62) 45/41 Stubble field at Stainton Vale Farm, Middlesbrough, JMB, January 1993.

Weissia longifolia var. *longifolia*: (62*) 45/41 Stubble field at Stainton Vale Farm, Middlesbrough, JMB, January 1993.

Racomitrium heterostichum: (62*) 45/61 On rock, 225 m alt., beside Lockwood Beck, JMB, 1992. Confirmation of this species in VC 62 following the recent revision of the complex.

Bryum gemmilucens: (63*) 44/61 In flax field, Thorne Ashfields, CW, August 1993.

Zygodon conoideus: (64) 34/67 On Hazel, Swilla Glen, Ingleton, TLB, August 1992.

Orthotrichum lyellii: (64) 44/24 In small quantity on Poplar, Golden Acre Park, Adel, Leeds, TLB, March 1993.

Orthotrichum pulchellum: (63*) 44/31 On *Salix* in wet ground, Newmillerdam, near Wakefield, TLB, May 1992; (64) 44/44 On elder, Cock Bridge, Stutton, TLB, April 1992. The only previous record for VC 63 was at Smeaton Crags, near Wentbridge, *c*. 1879.

Ulota crispa s.l.: (63) 44/21 On *Salix*, a few small tufts, Middlestown, near Horbury, TLB, February 1992. This material probably belongs to *U. bruchii* but requires mature capsules for safe determination. *U. bruchii* is now generally accepted as a distinct species from *U. crispa* (Smith & Proctor, 1993), and it may be more mobile than the latter.

Ulota bruchii (*U. crispa* var. *norvegica*) (63) 44/31 On *Salix* in wet ground, Newmillerdam, near Wakefield, TLB, May 1992; (64) 44/24 On Salix in wet ground, Golden Acre Park, Adel, Leeds, TLB, March 1993.

Ulota phyllatha: (64) 44/42 In small quantity on Poplar, Golden Acre Park, Adel, Leeds, TLB, March 1993.

Amblystegium tenax: (63) 44/22 At edge of small stream, Oakwell Hall, Birstall, TLB, August 1992.

References

Blockeel, T. L. (1984) The moss *Cryphaea heteromalla* refound in Yorkshire. *Bull. Yorks. Nat. Union* **2**: 11.

Blockeel, T. L. (1994) Field Excursion to Hackfall Wood, 19 September 1993. *Bull. Br. bryol. Soc.* **63**: 26.

Hodgetts, N. G. & Blockeel, T. L. (1992) *Thamnobryum cataractarum*, a new species from Yorkshire, with observations on *T. angustifolium* and *T. fernandesii*. *J. Bryol.* **17**: 251-262.

Rumsey, F. J. (1992) The status of *Tortula freibergii* in the British Isles. *J. Bryol.* **17**: 371-373.

Smith, A. J. E. & Proctor, M. C. F. (1993) Further observations on the *Ulota crispa* complex. *J. Hattori Bot. Lab.* **74**: 171-182.

GREY WAGTAIL

Photo: Richard Vaughan

Grey Wagtail (*Motacilla cinerea*). A male bird is shown here leaving its nest in a hollow in an ancient oak lintel over a barn door in Farndale. In summer 1993 this pair of Grey Wagtails raised a first brood of five young in the nest shown here, and a second brood of four young in a hole in the wall of an adjoining cowshed.

A Calendar of the Correspondence of Charles Darwin, 1821-1882. Pp. viii + 690 (2 b/w plates), plus supplement iv + 46. Cambridge University Press. 1994. £95.00.

Documenting Charles Darwin's copious correspondence, of which eight volumes (already reviewed in *The Naturalist*) taking us up to 1860 have be published so far, is a truly monumental undertaking. Not surprisingly, CUP has felt it necessary to reissue the *Calendar*, first published by The American Council of Learned Societies in 1985, augmented by a Supplement containing references to over 500 newly located letters and additions and corrections to the provenance, biographical register and bibliographical sections; to aid cross-reference to the main body of the work, a symbol adjacent to the nearest *Calendar* number has been provided to alert readers to a supplementary entry.

This encyclopaedic work is indispensable for Darwin scholars, and a very important reference source for those engaged in research on evolution and on the history of biological science. Certainly, every self-respecting natural sciences library should purchase this invaluable work.

MRDS

Printed in Great Britain by Titus Wilson & Son, Kendal

ISSN 0028-0771